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(54) Method of attaching an article to the inside of a tyre cavity

(57) A method of attaching an article (3) to the inside surface (S) of a pneumatic tyre characterised by coating an area of the inner surface of an uncured tyre carcass with a first layer (1) of adhesive, covering the first layer (1) of adhesive with a removable masking layer (M) comprising a flexible and heat resistant material, curing the tyre carcass in a heated tyre mould, removing the cured tyre from the mould and removing the masking layer (M) to expose the first layer (1) of adhesive, coating a face of the article (3) with a second layer of adhesive (2) and attaching the article to the tyre by bringing together the first (1) and second (2) layers of adhesive.

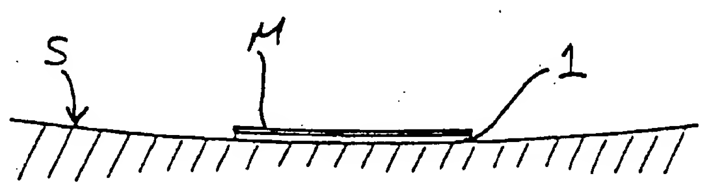

FIG. 1

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Description

[0001] The present invention relates to a method of attaching an article to the inside of a tyre cavity. Specifically the invention relates to a method of attaching an electronic microchip to the innerlining of a pneumatic tyre.

[0002] Recently it has been proposed to provide a pneumatic tyre with an electronic microprocessor or microchip which may be used to record and monitor operating parameters such as temperature or temperature history of the tyre in use on a vehicle.

[0003] Attaching such a microchip to the outer surface of the tyre, such as the sidewall, is clearly not a particularly viable option in view of the likelihood of damage due to physical impact or exposure to water or the like. The alternative of attaching the electronic component to the inside of the tyre is also problematic since the innerliners of modern tubeless pneumatic tyres invariably comprise one or more of a number of highly saturated butyl rubbers which in the cured state exhibit insufficient chemical reactivity to most practical adhesive systems to generate a reliable bond.

[0004] Accordingly hitherto it has been proposed to incorporate such a microchip within the tyre carcass. One proposal has been to bury the microchip inside the bulky apex rubber in the tyre bead region, but this is not found to be satisfactory as it requires the electronic component to withstand the rigours of tyre building

[0005] Accordingly it is an object of the present invention to provide a method of securely adhering an article such as an electronic microchip component to the inside of a tubeless pneumatic tyre.

[0006] According to one aspect of the invention there is provided a method of attaching an article to the inside surface of a pneumatic tyre comprising coating an area of the inner surface of an uncured tyre carcass with a first layer of flexible adhesive, covering the first layer of adhesive with a removable masking layer comprising a flexible and heat resistant material, curing the tyre carcass in a heated tyre mould, removing the cured tyre from the mould and removing the masking layer to expose the first layer of adhesive, coating a face of the article with a second layer of flexible adhesive and attaching the article to the tyre by bringing together the first and second layers of adhesive.

[0007] By applying the first layer of adhesive to the inner surface of the tyre whilst the rubber is in an uncured state, there exists sufficient reactivity between the adhesive and the rubber surface to assure an adequate bond.

[0008] Further aspects of the invention will become apparent from the following description by way of example only of an embodiment of the invention in conjunction with the following diagrammatic drawings in which:

Figure 1 shows a first layer of adhesive applied to the inner surface of a tyre and covered with a masking layer;

Figure 2 shows the first layer of adhesive of Figure 1 exposed by removal of the masking layer after tyre moulding;

Figure 3 shows a microprocessor coated with a second layer of adhesive;

Figure 4 shows the microprocessor adhered to the tyre; and

Figure 5 shows details of the dimensions of the thickness of adhesive.

[0009] The present invention relates to the problem of adhering an article such as a microchip to the inner surface of a tyre. Microchips and similar electronic devices are invariably housed in rigid plastic cases in order to protect the delicate electronics. In order to successfully mount such a component it is necessary to space it apart from the tyre surface using a flexible adhesive, capable of withstanding the inevitable shearing forces generated as the tyre deforms in use.

[0010] Shown in Figure 1 is a first layer of adhesive 1 applied to an area of the surface 5 of the rubber innerliner of a tubeless pneumatic tyre. The adhesive may be applied by any practical means such as knife spreading or roller coating.

[0011] After application to the tyre inner surface 5 the first adhesive layer 1 is completely covered by a masking layer (M) of a flexible heat resistant material which has the further property of only limited adhesion to the adhesive of the first layer 1 such that it can be subsequently removed.

[0012] In accordance with the invention the first layer of adhesive may alternatively be pre-applied to the masking layer and then both applied to the inside surface of the tyre.

[0013] The tyre with the first layer of adhesive 1 and masking layer M is then cured in a heated mould in the conventional manner. The presence of the masking layer M thus prevents the adhesive layer from being contaminated on the moulding process and from adhering to the moulding bladder and also discourages the adhesive layer from further spreading under the influence of the applied moulding pressure.

[0014] After the cure is complete the tyre is demoulded and the masking layer M is removed to expose the first adhesive layer as shown in Figure 2. Depending on the particular thickness of the first adhesive layer, the thickness of the masking layer M and the pressure applied in moulding the adhesive layer may be left on the tyre surface a shown or may be partially or completely impressed into the rubber or even lie below the level of the surrounding rubber.

[0015] In another operation shown in Figure 3, a surface of the microchip 3 is coated with a second layer of adhesive 2. Again the coating may be done by a conventional means.

[0016] Subsequently in the final operation the second layer of adhesive 2 is brought into contact with the

first adhesive layer 1 to adhere the microchip 3 to the tyre innerliner surface 5 as shown in Figure 4.

[0017] It has been found that for the material of the first adhesive layer 1 a non-curing acrylic adhesive available from 3M as **"VHB" A10** is particularly suitable for adhering to halo-butyl (chlorobutyl and bromobutyl) innerliners commonly used in tyres. This material is flexible and is said to be stable over an operating temperature range of -30° to +260° with a maximum continuous operating temperature of 150° and is therefore well suited to enduring a tyre curing process which typically reaches temperatures of 170-180°C. The thickness of the layer may be in the range 0.05 mm to 2.0 mm, but is preferably 0.25 mm.

[0018] In conjunction with the first adhesive material, the use of a masking layer M of a polyester film such as that available under the trade name **MYLAR** having a thickness in the range of 0.03 mm to 0.2 mm has been found suitable. A film thickness of 0.08 mm is particularly preferred. Such a polyester film is believed to have a melting temperature in excess of 230°C.

[0019] For the material of the second adhesive layer, another flexible non-curing acrylic adhesive available from 3M as **"VHB" 4918F** has been found effective with the above material of the first layer. This adhesive is believed to be stable over an operating temperature range of -30° to 150°C with a lower maximum continuous operating temperature of 93°C. The thickness of this second layer may be in the range 0.5 mm to 4.0 mm but is preferably 2.0 mm. Whilst the above embodiment employs two different adhesives, the materials of both the first and second layers of adhesive may however be the same material.

[0020] In a preferred arrangement the thicknesses of the first and second layers are selected such that the adhered microchip is held from the tyre surface by a minimum distance of between 2% and 8%, preferably 4%, of its maximum linear dimension along the adhered surface, i.e. the surface to which the second adhesive layer is applied. This is illustrated in Figure 5 which shows a plan view (5a) and front and side views (5b,5c) of a microchip (3) mounted on a tyre surface (S). Thus in accordance with the invention the microchip (3) is held from the tyre surface (5) by a distance (d) which is between 2% and 8% of the maximum dimension (D) of the microchip module along its adhering surface which since this is rectangular in shape is the diagonal.

[0021] If the separating distance (d) is too small then the shear gradient through the adhesive layers becomes too large and the bond fails, and if (d) is too large it is unnecessarily wasteful of adhesive and may be prone to trapping air between the adhesive layers.

[0022] In accordance with the invention, only a portion of the first adhesive layer may be initially utilised in adhering a microchip. The remainder of the adhesive layer may be left unexposed for subsequent use in adhering another microprocessor perhaps performing a different function or a replacement microchip for example if the tyre is retreaded. Alternatively of course two or more such areas of first layer of adhesive may be provided for similar subsequent additional microprocessors.

[0023] Accordingly the present invention provides a method by which a microchip may be conveniently and securely attached to the inner surface of a tubeless pneumatic tyre for the purpose of monitoring its operating parameters.

Claims

1. A method of attaching an article (3) to the inside surface (S) of a pneumatic tyre characterised by coating an area of the inner surface of an uncured tyre carcass with a first layer (1) of adhesive, covering the first layer (1) of adhesive with a removable masking layer (M) comprising a flexible and heat resistant material, curing the tyre carcass in a heated tyre mould, removing the cured tyre from the mould and removing the masking layer (M) to expose the first layer (1) of adhesive, coating a face of the article (3) with a second layer of adhesive (2) and attaching the article to the tyre by bringing together the first (1) and second (2) layers of adhesive.

2. A method according to claim 1, characterised in that the first layer (1) of adhesive remains unchanged by the curing of the tyre.

3. A method according to either of claims 1 or 2, characterised in that the first layer (1) of adhesive comprises a non-curing acrylic adhesive material being stable at temperatures up to 200°C.

4. A method according to any of claims 1 to 3, characterised in that the second layer (2) of adhesive comprises a non-curing adhesive material being stable at temperatures up to 150°C.

5. A method according to any of claims 1 or 4, characterised in that the first and second layers (1,2) of adhesive are the same adhesive.

6. A method in accordance with any of claims 1 to 5, characterised in that the adhered article (3) is separated by the adhesive layers (1,2) from the surrounding rubber surface (S) by a minimum distance (d) equal to between 2% and 8% of the maximum linear distance (D) along the adhering surface of the article (3).

7. A method according to any of claims 1 to 6, characterised in that the first layer (1) of adhesive has a thickness in the range of 0.05 mm to 2.0 mm.

8. A method according to any of claims 1 to 7, charac-

terised in that the second layer (2) of adhesive has a thickness of 0.5 mm to 4.0 mm.

9. A method according to any of claims 1 to 8, characterised in that the masking layer (M) comprises a polyester film.

10. A method according to any of claims 1 to 9, characterised in that the masking layer (M) has a thickness in the range of 0.03 mm to 0.2 mm.

FIG. 1

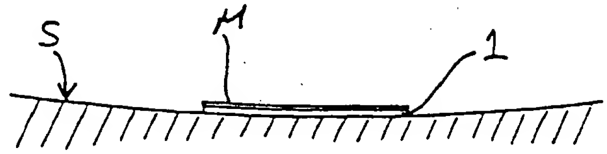

FIG. 2

FIG. 3

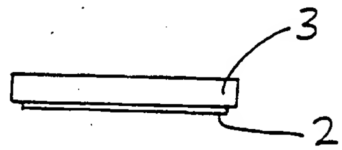

FIG. 4

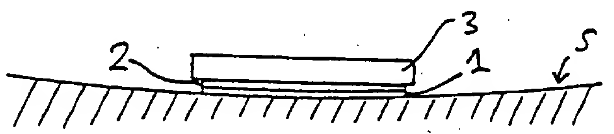

FIG. 5